THE DESCRIPTION AND USES OF A GENERAL QUADRANT,

WITH THE HORIZONTAL PROJECTION, UPON IT INVERTED.

Written and Published

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The Deſcription

OF THE

HORIZONTAL QUADRANT.

THis Denomination is attributed to it becauſe it is derived from the Horizontal projection inverted.

Of the Fore-ſide.

On the right edge is a Line of natural Sines. On the left edge a Line of Verſed-Sines. Both theſe Lines iſſue from the Center where they concurre and make a right Angle, and between them and the Circular Lines in the Limb is the Projection included, which conſiſts of divers portions and Arkes of Circles.

Of the Parallels of Declination.

THeſe are portions of Circles that croſſe the quadrant obliquely from the left edge, towards the right.

To describe them.

OBserve that the left edge of the quadrant is called the Meridian Line, and that every Degree or Parallel of the Suns Declination if continued about would crosse the Meridian in two opposite points, the one below the Center towards the Limbe, and the other above, and beyond the Center of the quadrant, the distance between these two points is the Diameter of the said Parallel, and the Semidiameters would be the Center points.

It will be necessary in the first place, to limit the outwardmost Parallel of Declination, which may be done in the Meridian Line at any point assumed.

The distance of this assumed point from the Center in any Latitude, must represent the Tangent of a compound Arke, made by adding halfe the greatest Meridian Altitude to 45 Deg. which for *London* must be the Tangent of 76 Degr.

And to the Radius of this Tangent must the following work be fitted.

In like manner, the Semidiameters of all other Parallels that fall below the Center, are limited by pricking downe the Tangents of Arkes, framed by adding halfe the Meridian Altitude suitable to each Declination continually to 45 Degr.

Now to limit the Semidiameters above or beyond the Center onely prick off the respective Tangents of half the Suns mid-night Depression from the Center the other way, retaining the former Radius, by this meanes there will be found two respective points limiting the Diameters of each Parallel, which had, the Centers will be easily found falling in the middle of each Diameter.

But to doe this Arithmetically, first, find the Arke compounded of halfe the Suns meridian Altitude, and 45 Degr. as before, and to the Tangent thereof, adde the Tangent of halfe the Suns mid-night depression, observing that the Suns mid-night depression in Winter/Summer, is equal to his Meridian Altitude in Summer/Winter, his declination being alike in quantity, though in different Hemispheres, the halfe summe of these two Tangents are the respective Semidiameters sought, and being prickt in the meridian line either

either way from the former points limiting the Diameters, will find the Centers.

Or without limiting those Points for the Diameters: first, get the Difference between the Tangents of those Arkes that limit them on either side, and the halfe summe above-said, the said difference prickt from the Center of the quadrant in the meridian line finds the respective Centers of those Parallels, the said halfe summes being the respective Semidiameters wherewith they are to be described.

Of the Line or Index of Altitudes.

THis is no other then a single prickt line standing next the Meridian line, or left edge of the quadrant, to which the Bead must be continually rectified, when either the houre or Azimuth is found by help of the projection.

To graduate it.

ADde halfe the Altitudes respectively whereto the Index is to be fitted to 45 Degr. and prick downe the Tangents of these compound arkes from the Center.

Example.

To graduate the Index for 40 Degr. of Altitude, the halfe thereof is 20, which added to 45 Degr. makes 65 Degr. which taken from a Tangent to the former Radius, and prickt from the Center, gives the point where the Index is to be graduated with 40 Degrees.

Hence it is evident that where the divisions of the Index begin marked (o) the distance of that point from the Center is equal to the common Radius of the Tangents. Because this quadrant (as all natural projections) hath a reverted taile, the graduations of the Index are continued above the Horizontal point (o) towards the Center to 30 Degr. 40′ as much as is the Sunnes greatest Vertical Altitude in this Latitude, and the graduations of the Index are set off from the Center by prick-

ing downe the Tangents of the arkes of difference between half the proposed Altitude, and 45 Deg. thus to graduate 20 deg. of the Index the halfe thereof is 10 Degrees, which taken from 45 Degrees, the residue is 35 Degrees, the Tangent thereof prickt from the Center gives the point where the Index is to be graduated with 20 Degrees.

Of the houre Circles.

THese are knowne by the numbers set to them by crossing the Parallels of Declination, and by issuing from the upper part of the quadrant towards the Limbe.

To describe them.

LEt it be noted that they all meet in a point in the Meridian Line below the Center of the quadrant: the distance whereof from the Center is equal to the Tangent of halfe the Complement of the Latitude taken out of the common Radius, which at *London* will be the Tangent of 19 Deg. 14′.

The former point which may be called the Pole-point, limits their Semidiameters, to find the Centers prick off the Tangent of the Latitude and through the termination raise a line Perpendicular to the Meridian line, the distance from the Pole-point being equal to the Secant of the Latitude, must be made Radius. And the Tangents of 15 Degrees, 30 Degrees &c. prickt off on the former raised line, gives the respective Centers of the houre Circles, the distances whereof from the Pole point are the Semidiameters wherewith those houre Circles are to be drawne.

Of the reverted Tail.

THis needs no Rule to describe it, being made by the continuing of the parallels of Declination to the right edge of the quadrant and the houre Circles up to the Winter Tropick or parallel of Declination neerest the Center, however the quantity of it may be knowne by setting one foot of a paire of Compasses in the Center

Center of the quadrant, and the other extend to 00 Degrees of Altitude in the Index; an Arch with that extent swept over the quadrant as much as it cuts off will be the Reverted Taile, and so much would be the Radius.

Of a Quadrant made, of this Projection not inverted.

BY what hath been said it will be evident to the judicious that this inversion is no other then the continance of the extents of one quarter of the Horizontal projection.

Which otherwise could not with convenience be brought upon a quadrant.

Hence it may be observed that.

Having assigned the Radius, a quadrant made of the Horizontal Projection without inversion, to know how big a Radius it will require when inverted the proportion will hold.

AS the Radius, is to the distance of the intersection of the Æquinoctial point with the Horizon from the Center equall to the Radius of the said Projection when not inverted, in any common measure.

So is the Tangent of an Arke compounded of 45 Degrees, and of half the Suns greatest Meridian Altitude.

To the distance between the Center and the out-ward Tropick next the Limbe in the said known measure when inverted, whence it followes that between the Tropicks this projection cannot be inverted, but the reverted taile will be but small, and may be drawne with convenience without inversion.

Of the Curved Line and Scales belonging to it.

BEyond the middle of the Projection stands a Curved or bending Line, numbred from the O or cypher both wayes, one way to 60 Degrees, but divided to 62 Degrees, the other way to 20 Degr. but divided to 23 Deg. 30′.

The

The Invention of this Line ownes Mr. *Dary* for the Author thereof, the Use of it being to find the houre or Azimuth in that particular latitude whereto it is fitted by the extension of a threed over it, and the lines belonging to it.

The lines belonging to it are two, the one a Line of Altitudes, and Declinations standing on the left edge of the quadrant, being no other but a line of Sines continued both wayes, from the beginning one way to 62 Degrees, the other way to 23. Degrees 30′.

The other line thereto belonging is 130 Deg. of a line of Versed Sines, which stands next without the Projection being parallel to the left edge of the quadrant.

To drawv the Curve.

DRaw two lines of Versed Sines, it matters not whether of the same Radius or no, nor how posited; provided they be parallel, let each of them be numbred as a Sine both ways, from the middle at (o) and so each of them will containe two lines of Sines, to the right end of the uppermost set C, to the left end D, and to the right end of the undermost set A, and to the left end B.

First, Note that there is a certaine point in the Curve where the Graduations will begin both upwards and downwards, this is called the Æquinoctial point; to find it, lay a ruler from A to the Complement of the Latitude counted from (o) in the upper Scale towards D, and draw a line from A to it, then count it the other way towards C, *viz.* 38 Degrees 28′. for the Co-latitude of *London*, and lay a ruler over it, and the point B, and where it intersects the line before drawn, is the Æquinoctial point to be graduated.

Then to graduate the Division on each side of it, requires onely the making in effect of a Table of Meridian altitudes to every degree of Declination (which because the Curve will also serve for the Azimuth in which case the graduations of the Curve, which in finding the houre were accounted Declinations must be accounted Alti-

Altitudes) must be continued to 62 Degrees for this Latitude, and further also if it be intended that the Curve shall find a Stars houre that hath more declination.

To make this Table.

GEt the Summe and difference of the Complement of the latitude and of the Degrees intended to be graduated, and if the summe exceed 90 Degrees, take its complement to 180 degrees instead of it: being thus prepared the Curve will be readily made.

To graduate the under part of the Curve.

Account the summe in the upper line from O towards D, and from the point A in the under line draw a line to it.

Account the difference in the upper line when the degree proposed to be graduated is lesse then the complement of the Latitude from O towards C: but when it is more towards D, and from the point B lay a Ruler over it, and where the Ruler intersects, the line formerly drawn is the point where the degree proposed is to be gradrated.

Example.

Let it be required to find the point where 60 deg. of the Curve is to be gradrated.

Arke proposed	60 deg.
Co-latitude	38 : 28
	98 : 28
Summe	81 : 32
Difference	21 32

Count 81 deg. 32′ in the upper line from O towards D, and from the point A draw a line to it.

Count the difference 21 degrees 32′ from O towards D, because the co-latitude is lesse then the arke proposed, and lay a Ruler over it, and the point B, and where it intersects the former

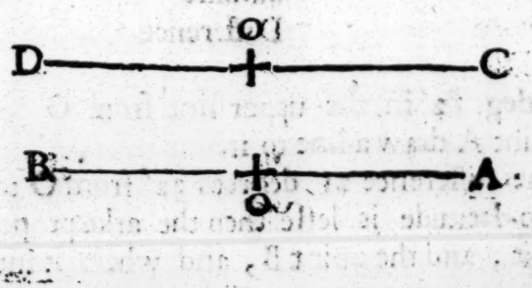
mer line is the point where 60 deg. of the Curve is to be graduated on the lower side.

Another Example.

Let it be proposed to graduate the same way,

The arke of 30 degr.	30 degr.
Co-latitude	38 : 28
Summe	68 : 28
Difference	8 : 28

Count 68 deg. 28′ from O towards D, and from the point A draw a line to it. Again in the said upper line, count 8 deg. 28′ upwards from O towards C, & from the point B lay a ruler over it, & where it intersects the line last drawn is the point where 30 d. of the curve is to be graduated. To graduate the upper part of the curve requires no other directions, the same arkes serve, if the account be but made the other way, and in accounting the summe the ruler laid over B in the lower line instead of A, and in counting the difference over A, instead of B, neither is there any Scheme given hereof, the Practitioner need onely let the upper line be the line of altitudes on the left edge of the quadrant continued out to 90 deg. at each end, and to that end next the Center set C, and to the other end D. So likewise let that end of the Versed Scale next the right edge of the quadrant be continued to 180 deg. whereto set A, and at the other end B, and then if these directions be observed, and the same distance and position of the lines retained, it will not be difficult to constitute a Curve in all respects agreeing with that on the fore-side of the quadrant.



Of the houre and Azimuth Scale on the right edge of the Quadrant.

THis Scale ſtands outwardmoſt on the right edge of the quadrant, and conſiſts of two lines, the one a line of 90 ſines made equal to the coſine of the Latitude, namely, to the ſine of 38 deg. 28′, and continued the other way to 40 deg. like a Verſed ſine.

The annexed line being the other part of this Scale, is a line of natural Tangents beginniug where the former ſine began, the Tangent of 38 deg. 28′ being made equal to the ſine of 90 deg. this Tangent is continued each way with the ſine; towards the Limbe of the quadrant it ſhould have been continued to 62 deg. but that could not be without excurſion, wherefore it is broken off at 40 degrees, and the reſidue of it graduated below, and next under the Verſed ſine belonging to the Curve that runnes croſſe the quadrant being continued but to halfe the former Radius.

Of the Almanack.

NExt below the former line ſtands the Almanack in a regular ob-long with moneths names graved on each ſide of it.

Below the Almanack ſtands the quadrat, and ſhadowes in two Arkes of circles terminating againſt 45 deg. of the Limbe, below them a line of 90 ſines in a Circle equal to 51 deg. 32′ of the Limbe broken off below the ſtreight line, and the reſt continued above it.

Below theſe are put on in Circles a line of Tangents to 60 degrees.

Alſo a line of Secants to 60 deg. with a line of leſſer ſines ending againſt 30 deg. of the Limbe (counted from the right edge) where the graduations of the Secant begins.

Laſt of all the equal Limbe.

Prickt with the pricks of the quadrat.

Abutting upon the line of ſines, and within the Projection ſtands a portion of a ſmall ſine numbred with its Complements beginning againſt 38 deg. 28′ of the line of ſines, this Scale is

called the Scale of entrance. Upon the Projection are placed divers Stars, how they are inscribed shall be afterwards shewne.

The description of the Back-side.

Put on in quarters or Quadrants of Circles.

1 THe equal Limbe divided into degrees, as also into houres and halves, and the quarters prickt to serve for a Nocturnal.

2 A line of Equal parts.

3 A line of Superficies or Squares.

4 A line of Solids or Cubes.

5 A Tangent of 45 degrees double divided to serve for a Dyalling Tangent, and a Semitangent for projections.

6 The line Sol, *alias* a line of Proportional Sines.

7 A Tangent of 51 degrees 32′ through the whole Limbe.

8 A line of Declinations for the Sun to 23 deg. 31′.

9, 10, 11, 12 } Foure quadrants with the days of the Moneth.

13 The Suns true place, with the Charecters of the 12 Seignes.

14 The line of Segments, with a Chord before they begin.

15 The line of Metals and Equated bodies.

16 The line of Quadrature.

17 The line of Inscribed bodies.

18 A line of 12 houres of Ascension with Stars names, Declinations, and Ascensional differences.

Above all these a Table to know the Epact, and what day of the Weeke, the first day of *March* hapned upon, by Inspection continued to the Yeare 1700.

All these between the Limbe and the Center.

ON the right edge a line of equal parts from the Center decimally sub-divided, being a line of 10 inches; also a Dyalling Tangent or Scale of 6 houres, the whole length of the quadrant not issuing from the Center.

On the left edge a Tangent of 60 deg. 26′ from the Center.

Also a Scale of Latitudes fitted to the former Scale of houres not issuing from the Center, and below it a small Chord.

The Uses of the Quadrant.

Lords- day	1657 25	63 1	68 26	74 3	☉	85 4	91 11	96 6	anno epact
Mon- day	58 6	☾	69 7	75 14	80 9	86 15	☽	97 17	anno epact
Tues- day	59 17	64 12	70 18	♂	81 20	87 26	92 22	98 28	anno epact
Wednes- day	☿	65 23	71 29	76 25	82 1	☿	93 3	99 9	anno epact
Thurs- day	60 28	66 4	♃	77 6	83 12	88 7	94 14	♃	anno epact
Fri- day	61 9	67 15	72 11	78 17	♀	89 18	95 25	700 20	anno epact
Satur- day	62 20	♄	73 22	79 28	84 23	90 29	♄	701 1	anno epact

Dayes the ſame as the firſt of *March.*

March	1	8	15	22	29	*November*
Auguſt	2	9	16	23	30	*Auguſt*
May	3	10	17	24	31	*Jnuary*
October	4	11	18	25	0	*October*
April	5	12	19	26	00	*July*
Septem.	6	13	20	27	00	*December*
June	7	14	21	28	00	*February*

Perpetual Almanack.

Of the Uſes of the Projection.

BEfore this Projection can be uſed, the Suns declination is required,& by conſequence the day of the moneth for the ready finding thereof there is repeated the ſame table that ſtands on the Back-ſide of this quadrant in each ruled ſpace,the uppermoſt figure ſignifies the yeare of the Lord, and the column it is placed in ſheweth upon what day of the Weeke the firſt day of March hapned upon in that yeare, and the undermoſt figure in the ſaid ruled ſpace ſheweth what was the Epact for that yeare and this continued to the yeare 1701 incluſive.

Example.

Looking for the yeare 1660 I find the figure 60 ſtanding in *Thurſday* Column, whence I may conclude that the firſt day of *March* that yeare will be T*hurſday*, and under it ſtands 28 for the *Epact* that yeare.

Of the Almanack.

HAving as before found what day of the Weeke the firſt day of *March* hapned upon, repaire to the Moneth you are in, and thoſe figures that ſtand againſt it ſhewes you what dayes of the ſaid moneth the Weeke day ſhall be, the ſame as it was the firſt day of *March.*

Example For the yeare 1660, having found that the first day of *March* hapned upon a *Thursday*, looke into the column against *June*, and *February*, you will find that the 7th, 14th, 21th and 28th dayes of those Moneths were *Thursdayes*, whence it might be concluded if need were that the quarter day or 24th day of *June* that yeare hapneth on the *Lords day*.

Of the Epact.

THe *Epact* is a number carried on in account from yeare to yeare towards a new change, and is 11 dayes, and some odde time besides, caused by reason of the Moons motion, which changeth 12 times in a yeare Solar, and runnes also this 11 dayes more towards a new change, the use of it serves to find the Moones age, and thereby the time of high Water.

To know the Moons age.

ADde to the day of the Moneth the *Epact*, and so many days more, as are moneths from *March* to the moneth you are in, including both moneths, the summe (if lesse then 30) is the Moones age, if more, subtract 30, and the residue in the Moons age (*prope verum.*)

Example.

The *Epact* for the year 1658 is 6, and let it be required to know the Moons age the 28 of *July*, being the fift moneth from *March* both inclusive

$$\begin{array}{r} 6 \\ 28 \\ 5 \\ \hline 39 \end{array}$$

The summe of these three numbers is 39

Whence rejecting 30, the remainder is 9 for the Moons age sought.

The former Rule serves when the Moneth hath 31 dayes, but if the Moneth hath but 30 Dayes or lesse, take away but 29 and the residue is her age.

To find the time of the Moones comming to South.

MUltiply the Moones age by 4, and divide by 5, the quotient shewes it, every Unit that remaines is in value twelve minutes of time, and because when the Moon is at the full, or 15 dayes, old shee comes to South at the houre of 12 at midnight, for ease in multiplication and Division when her age exceedes 15 dayes reject 15 from it.

Example,

So when the Moon is 8 dayes old, she comes to South at 24 minutes past six of the clock, which being knowne, her rising or setting may be rudely guessed at to be six houres more or lesse before her being South, and her setting as much after, but in regard of the varying of her declination no general certaine rule for the memory can be given.

Here it may be noted that the first 15 dayes of the Moones age she commeth to the Meridian after the Sun, being to the Eastward of him, and the later 15 dayes, she comes to the Meridian before the Sun, being to the Westward of him.

To find the time of high Water.

TO the time of the Moones comming to South, adde the time of high water on the change day, proper to the place to which the question is suited, the summe shewes the time of high water.

For

For *Example*, There is added in a Table of the time of high Water at *London*, which any one may cast up by memory according to these Rules, it is to be noted, that Spring Tides, high winds, and the Moon in her quarters causes some variation from the time here expressed.

Moones age Dayes.		*Moon South Ho.*	*mi.*	*Tide London Ho.*	*Mi*
0	15	12	—	3	00
1	16	12	48	3	48
2	17	1	36	4	36
3	18	2	24	5	24
4	19	3	12	6	12
5	20	4		7	00
6	21	4	48	7	48
7	22	5	36	8	36
8	23	6	24	9	24
9	24	7	12	10	12
10	25	8	00	11	00
11	26	8	48	11	48
12	27	9	36	12	36
13	28	10	24	1	24
14	29	11	12	2	12

This Rule may in some measure satisfie and serve for vulgar use for such as have occasion to go by water, and but that there was spare roome to grave on the Epacts nothing at all should have been said thereof.

A Table shewing the houres and

Minutes to be added to the time of the Moons comming to South for the places following being the time of high Water on the change day.

	H. m.
Quinborough, Southampton, Portsmouth, Isle of Wight, Beachie, the Spits, Kentish Knocke, half tide at Dunkirke.	00 : 00
Rochester, Maulden, Aberdeen, Redban, West end of the Nowre, Blacktaile.	00 : 45
Gravesend, Downes, Rumney, Silly half tide, Blackness, Ramkins, Senihead.	1 : 30

C *Dundee*

Dundee, St. Andrewes, Lixborne, St. Lucas, Bel Isle, Holy Isle.	2 : 15
London, Tinmouth, Hartlepoole, Whitby, Amsterdam, Gascoigne, Brittaine, Galizia.	3 : 00
Barwick, Flamborough head, Bridlington bay, Ostend, Flushing, Bourdeaux, Fountnesse.	3 : 45
Scarborough quarter tide, Lawrenas, Mountsbay, Severne, Kingsale, Corke-haven, Baltamoor, Dungarvan, Calice, Creeke, Bloy seven Isles.	4 : 30
Falmouth, Foy, Humber, Moonles, New-castle, Dartmouth, Torbay, Caldy Garnesey, St. Mallowes, Abrowrath, Lizard.	5 : 15
Plymouth, Weymouth, Hull, Lin, Lundy, Antwerpe, Holmes of Bristol, St. Davids head, Concalo, Saint Malo.	6 : 00
Bristol, foulnes at the Start.	6 : 45
Milford, Bridg-water, Exwater, Lands end, Waterford, Cape cleer, Abermorick, Texel.	7 : 20
Portland, Peterperpont, Harflew, Hague, St. Magnus Sound, Dublin, Lambay, Muckwels Castle.	8 : 15
Poole, S. Helen, Man Isle, Catnes, Orkney, Faire Isles, Dunbar, Kildren, Basse Islands, the Casquers, Deepe at halfe tide.	9 :
Needles, Oxford, Laysto, South and North Fore-lands.	9 : 45
Yarmouth, Dover, Harwich, in the frith Bullen, Saint John de luce, Calice road.	10 : 30
Rye, Winchelsea, Gorend, Rivers mouth of Thames, Faire Isle Rhodes.	11 : 15

To

To find the Epact for ever.

IN Order hereto, first, find out the *Prime* Number divide the yeare of the Lord by 19 the residue after the Division is finished being augmented by an Unit is the *Prime* sought, and if nothing remaine the *Prime* is an Unit.

To find the Epact.

MUltiply the *Prime* by 11, the product is the *Epact* sought if lesse then 30, but if it be more, the residue of the Product divided by 30 is the *Epact* sought, there note that the *Prime* changeth the first of *January*, and the *Epact* the first of *March*.

Otherwise.

Having once obtained the *Epact* adde 11 to it the Summe if lesse then 30 is the *Epact* for the next yeare if more reject 30, and the residue is the *Epact* sought.

Caution.

When the *Epact* is found to be 29 for any yeare, the next yeare following it will be 11 and not 10, as the Rule would suggest.

A Table of the Epacts belonging to the respective Primes.

Pr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ep.	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29

The Prime number called the *Golden Number*, is the number of 19 years in which space the Moone makes all variety of her changes, as if she change on a certain day of the month on a certain yeare she shall not change the same day of the moneth again till 19 yeares after: and then it doth not happen upon the same houre of the day, yet the difference doth not cause one dayes variation in 300 yeares, as is observed by Mr. *Philips*.

The Uses of the Quadrant.

WIthout rectifying the Bead nothing can be performed by this Projection, except finding the Suns Meridian Altitude being shewn upon the Index, by the intersection of the Parallel of declination therewith.

Also the time when the Sun will be due East or West.

TRace the Parallel of Declination to the right edge of the Projection, and the houre it there intersects (in most cases to be duly estimated) shewes the time sought, thus when the Sun hath 21 deg. of North declination, we shall find that he will be due East or West, about three quarters of an houre past 4 in the afternoon, or a quarter past 7 in the morning. The declination is to be found on the Back-side of the quadrant by laying the thread over the day of the moneth.

To rectifie the Bead.

LAy the thread upon the graduated Index, and set the Bead to the observed or given Altitude, and when the Altitude is nothing or when the Sun is in the Horizon set the Bead to the Cypher on the graduated Index, which afterwards being carried without stretching to the parallel of Declination the threed in the Limbe shewes the Amplitude or Azimuth, and the Bead amongst the houres shewes the true time of the day.

Example.

Upon the 24th of April the Suns declination will be found to 16 deg. North.

Now to find his Amplitude and the time of his rising, laying the threed over the graduated Index, set the Bead to the beginning of the graduations of the Index, and bring it without stretching to the parallel of declination above being 16 d. and the threed in the

limbe

limbe will lye over 26 deg. 18′ for the Suns Amplitude or Coast of rising to the Northward of the East, and the Bead amongst the houres sheweth 24 minutes past 4 for the time of Sun rising.

Which doubled gives the length of the night 8 houres 49 min.

In like manner the time of setting doubled gives the length of the day.

The same to find the houre and Azimuth let the given Altitude be 45 degrees.

HAving rectified the Bead to the said Altitude on the Index and brought it to the intersect, the parallel of declination the thread lyes over 50 degrees 48′.

For the Suns Azimuth from the South.

And the Bead among the houres shewes the time of the day to be 41 minutes past 9 in the morning, or 19 minutes past two in the afternoon.

Another Example wherein the operation will be upon the Reverted taile.

Let the altitude be	3 *deg.* 30′
And the declination	16 *deg. North as before.*

TO know when to rectify the Bead to the upper or neather Altitude will be no matter of difficulty, for if the Bead being set to the neather Altitude will not meet with the parallel of declination, then set it to the upper Altitude, and it will meet with Winter parallel of like declination, which in this case supplyes the turn.

So in this Example, the Bead being set to the upper Altitude of 3 deg. 30′ and carried to the Winter parallel of declination.

The thread in the Limbe will fall upon 68 deg. 28′ for the Suns Azimuth from the North, and the Bead among the houres shewes the time of the day to be either 5 in the morning or 7 at night.

Another Example.

Admit the Sun have 20 degr. of North Declination (as about the 9th of *May*) and his observed altitude were 56 deg. 20′ ha-ving

ving rectified the Bead thereto, and brought it to intersect the parallel of 20 deg. among the houres it shewes the time of the day to be 11 in the morning or 1 in the afternoon, and the Azimuth of the Sun to be 26 deg. from the South.

The Uses of the Projection.

TO find the Suns Altitude on all houres or Azimuths will be but the converse of what is already said, therefore one Example shall serve.

When the Sun hath 45 deg. of Azimuth from the South.
And his Declination 13 deg. Northwards.

Lay the threed over 45 deg. in the Limbe, and where the threed intersects the Parallel of Declination thereto remove the Bead which carried to the Index without stretching, shewes 43 deg. 50′ for the Altitude sought.

Likewise to the same Declination if it were required to find the Suns Altitude for the houres of 2 or 10.

Lay the threed over the intersection of the houre proposed with the parallel of Declination, and thereto set the bead which carried to the Index shewes the Altitude sought namely 44 deg. 31′.

The same Altitude also belongs to that Azimuth the threed in the former Position lay over in the Limbe.

This Projection is of worst performance early in the morning or late in the evening, about which time Mr. *Daries* Curve is of best performance whereto we now addresse our selves.

Of the curved line and Scales thereto fitted.

THis as we have said before was the ingenious invention of M. *Michael Dary* derived from the proportionalty of two like equiangled plain Triangles accommodated to the latitude of *London*, for the ready working of these two Proportions.

1 *For the Houre.*

As the Cosine of the Latitude, is to the secant of the Declination, So is the difference between the sine of the Suns proposed and Meridian Altitude.

To the versed sine of the houre from noone, and the converse, and so is the sine of the Suns Meridian Altitude, to the versed sine of the semidiurnal Arke.

2 *For the Azimuth.*

The Curve is fitted to find it from the South and not from the North, and the Proportion wrought upon it will be.

As the cosine of the Latitude, is to the Secant of the Altitude. So is the difference of the versed sines of the Suns (or Stars) distance from the elevated Pole, and of the summe of the Complements both of the Latitude and Altitude, to the versed sine of the Azimuth from the noon Meridian.

Which will not hold backward to find the Altitude on all Azimuths, because the altitude is a term involved, both in the second and third termes of the former proportion.

If the third terme of the former Proportion had not been a difference of Sines, or Versed sines, the Curved line would have been a straight-line, and the third term always counted from one point, which though in the use it may seem to be so here, yet in effect the third term for the houre is always counted from the Meridian altitude.

Here observe that the threed lying over 12 or the end of the Versed Scale, and over the Suns meridian altitude in the line of altitudes, it will also upon the curve shew the Suns declination, which by construction is so framed that if the distance from that point to the meridian altitude, be made the cosine of Latitude, the distance of the said point from the end of the versed Scale numbred with 12 shall be the secant of the declination to the same Radius, being both in one straight-line by the former constitution of the threed, and instead of the threed you may imagine a line drawn over the quadrant, then by placing the threed as hereafter directed

it

it will with this line & the fitted scales constitute two equiangled plaine triangles, upon which basis the whole work is built.

In the three first Proportions following relating to time, the Altitude must alwayes be counted upwards from O in the line of Altitude, and the Declination in the Curve upwards in Summer, downwards in Winter.

1 *To find the time of the Suns rising and setting by the Curve.*

WE have before intimated that the suns Declination is to be found on the back of the quadrant, having found it, lay one part of the thread over o deg. in the Line of Altitude, and extending it, lay the other part of it over the Suns Declination counted from O in the Curve, and the thread upon the Versed scale shewes the time of Suns rising and setting, which being as much from six towards noon in Winter as towards mid-night in Summer, the quantity of Declination supposed alike both wayes on each side the Equinoctial, the thread may be layd either way from O in the Curve to the Declination.

Example.

When the Sun hath 20 deg. of Declination, the thread being laid over 20 deg. in the Curve and O in the Altitude on the left edge shewes that the Sun riseth/setteth 1 houre 49′ before/after six in the Summer and riseth/setteth as much after/before six in the Winter.

2 *The Altitude and Declination of the Sun being given to find the houre of the day.*

COunt the Altitude from O in the Scale of Altitudes towards the Center, and thereto lay the thread, then count the Declination from O in the Curve, if North upwards towards the Center, if South downwards towards the Limbe.

And lay the thread extended over it, and in the Versed Scale it shewes the time of the day sought.

Example

Example.

The Altitude being 24 d. 46′ and the Declination 20 d. North counting that upwards in the Scale of Altitudes, and this upward in the curve, and extending the through thread, it will intersect the Versed Scale at 7 and 5, shewing the houre to be either 7 in the morning, or 5 in the afternoon.

Another Example for finding when twilight begins.

Let the Suns Declination be 13 deg. North, the Depression supposed 18 degr. under the Horizon.

In stead of the case propounded, suppose the Sun to have 13 deg. of South Declination, and Altitude 18 deg. above the Horizon accordingly extending the thread through 18 in the Altitudes counted upward from O in the line of Altitudes and through 13 deg. counted downward in the Curve from O, and upon the Versed Scale, the thread will shew that the Twilight begins at 28 minutes past 2 in the morning, and at 32 min. past 9 at night.

3 *The Converse of the last Proposition is to find the Suns altitudes on all houres.*

EXtend the thread over the houre proposed in the versed Scale and also over the Declination in the Curve counted upward if North, downward if South.

And in the Scale of Altitudes it shewes the Altitude sought.

Example.

If the Sun have 13 deg. of North Declination his Altitude for the houre of 7 in the morning, or 5 in the after-noon will be found to be 19 deg. 27′.

In the following Propositions the altitude must alwayes be counted from O in the Curve downwards, and the Declination in the line of altitudes, if North downward, if South upwards.

4 To find the Suns Amplitude or coast of rising and setting.

Example.

If the Sun had 20 deg. of Declination the thread being laid to ☉ in the Curve, and to 20 in the line of altitudes or Declinations, either upwards or downwards the thread will lye 33 deg. 21′ from 90 in the Versed Scale, for the quantity of the Suns Coast of rising or setting from the true East or West in Winter Southward, in Summer Norhward.

5 *The Suns altitude and Declination being proposed to find his Azimuth.*

COunt the altitude from ☉ in the Curve downward, and the declination in the Winter upon the line of Declinations from ☉ upwards, in Summer downwards, and the thread extended sheweth the Azimuth sought, on the Versed Scale.

Example.

So when the Sun hath 18 deg. 37′ of North Declination, as as about 19 *July*, if his altitude were 39 deg. the Suns Azimuth would be found to be 69 deg. from the South.

6 *The Converse of the former Proposition will be to find the Suns Altitude on all Azimuths.*

THe Instrument will perform this Proposition though the Porportion for finding the Azimuth cannot be inverted.

Lay the thread to the azimuth in the Versed Scale, and to the Declination in the Scale on the left edge, and upon the Curve it will intersect the altitude sought.

Example.

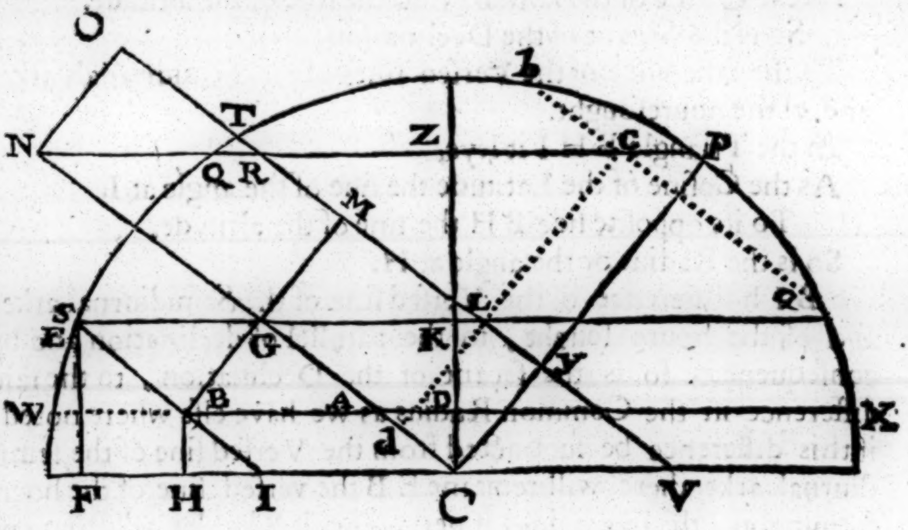
If the Sun had 16 deg. 13′ of South Declination, as about the 27th of *October*, if his Azimuth were 39 deg. from the South the altitude agreeable thereto would be found to be 14 deg.

These

These Uses being understood, if the houre and altitude or the azimuth and altitude were given to find the Declination, the manner of performance cannot lurke.

Of the Houre and Azimuth Scale on the right Edge of the Quadrant.

THis Scale being added by my selfe, and derived from Proportions in the Analemma, I shall first lay them down, and then apply them.



In the former Scheme draw F C V the Horizon, Z C the Axis of the Horizon, C P the axis of the Spheare G C continued to N the Equator, O L a parallel of North, and E I a parallel of South Declination, W X a parallel of winter altitude, S L a parallel of altitude lesse then the Complement of the latitude, N Z P a parallel of greater altitude, and from the points E and B. let fall the perpendiculars E F and B H, and from the points B G and N let fall the perpendiculars B G, G M, and N O which will be the sines of the Suns declination, by this meanes there will be divers right lined right angled plaine Triangles constituted

tuted from whence are educed, the Proportions following to calculate the Suns houre or Azimuth.

Note, first, that T V is the Versed sine of the Semidiurnal arke in Summer, and E I in Winter, and Y V the sine of the houre of rising before six in Summer, equal to the distance of I from the Axis continued in Winter, which may be found in the Triangle C Y V, but the Proportion is,

As the Cotangent of the latitude, To Radius.

So the Tangent of the Suns Declination,

To the sine of his ascentional difference, being the time of his rising from six, thus we may attaine the Semidiurnal arke.

Then for the houre in the Triangle B H I it holds.

As the Cosine of the latitude, to the sine of the altitude.

So is the Secant of the Declination.

To the difference of the Versed sines of the Semidiurnals arke, and of the houre sought.

In the Triangle B H I it leys.

As the Cosine of the Latitude the sine of the angle at I.

To its opposite side B H the sine of the altitude.

So is the Radius or the angle at H.

To B I h difference of the Versed sine of the Semidiurnal arke, and of the houre sought, in the parallel of declination and by consequence, so is the secant of the Declination, to the said difference in the Common Radius as we have else where noted, if this difference be subtracted from the Versed sine of the semidiurnal arke there will remaine E B the versed sine of the houre from noon, the like holds, if perpendiculars be let fall from any other parallel of Declination, from the same Scheme it also followes.

As the Cosine of the Latitude,

Is to the secant of the Declination.

So is the sine of the Meridian Altitude.

To the versed sine of the semidiurnal arke.

Here observe the like Proportion between the two latter terms, as between the two former which may be of use on a Sector.

If the Scheme be considered not as fitted to a peculiar question for finding the houre, but as having three sides to find an angle, it will be found upon such a consideration in relation to the change of sides, that the Proportion for the Azimuth following is no other then the same Proportion applyed, to other sides of the Triangle, and so we need have no other trouble to come by a Proportion for the Azimuth, but it also followes from the same Scheme.

In the Triangles C D A and C K G, and C Z N the first operation will be to find A D, and G K, and N R in all which the Proportion will hold.

As the Radius to the Tangent of the Latitude.

Or as the Cotangent of the Latitude to Radius.

So is the Tangent of the Altitude, to the said respective quantities, which when the Altitude is lesse then the Complement of the Latitude, are the sins of the Suns Azimuth from the Vertical belonging to the proposed Altitudes when the Sun is in the Equinoctial, or hath no declination.

The next proportion will be.

As the Cosine of the Latitude, Is to the Secant of the Altitude.

So is the Sine of the declination.

To the difference sought being a 4 Proportional.

Hereby we may find A B in the Winter Triangle A G B which added to A D; the summe is the sine of the Azimuth from the Vertical consequently W B, is the Versed sine of the Azimuth, from the noon Meridian.

Also we find G L in the Summer triangle L M G, when the Altitude is lesse then the Complement of the Latitude, which added to S G the summe S L is the Versed sine of the Azimuth from the South.

Likewise we may find N R in the Triangle R O N, and by subtracting it from N Z, there will remaine R Z, and consequently Q R the versed sine of the Azimuth from the Meridian in Summer when the Altitude is greater then the Co-latitude.

And for Stars that come to the Meridian between the Zenith, and the Elevated Pole, we may find N c, in the Triangle N c d

where it holds, as the sine of the Angle at N, the complement of the Latitude, to its opposite sides c d, the prickt line, the sine of the Declination: so is the Radius to N c, the parallel of altitude the Azimuth sought.

The latter Proportion lyes so evident, it need not be spoken to, if what was said before for the houre be regarded, and the former Proportion lyes.

As the Cosine of the Latitude, the sine of the Angle at A.
To its Opposite side D C, the sine of the altitude.
So is the sine of the Latitude, the angle at C.
To its opposite side A D in the parallel of altitude.
And in stead of the Cosine, and sine of the Latitude.
We may take the Radius, and the Tangent of the Latitude.

Another Analogy will be required to reduce it to the common Radius.

As the Cosine of the Altitude to Radius.
So the fourth before found in a parallel.
To the like quantity to the Common Radius.

These Analogies or Proportions being reduced into one, by multiplying the termes of each Proportion, and then freed from needlesse affection will produce the Proportion at first delivered.

The Uses of the said Scale.

WE have before noted, that if two termes of a Proportion be fixed, and naturall lines thereto fitted of an equal length, that if any third term be sought in the former line, the fourth term will be found in the other line by inspection, as standing against the third.

So here, in this Scale which consists of two lines, the one an annexed Tangent, the other a line of Sines continued both wayes, the Radius of the Sines being first fitted, the Tangent annexed must be of such a Radius, as that 38 deg. 28′, of it may be equall in length to the Radius of the Sine to which it is adjoyned, and

and then looking for the Declination in the Tangent just against it stands the time of rising, from six or ascentional difference, or the Semidiurnal arke, if the same be accounted from the other end as a Versed Sine.

So if the Suns Altitude be given, and accounted in the Tangent, just against it stands the Suns Azimuth, when he is in the Equinoctial upon the like altitude, and thus the point N. will be found in the Tangent at the altitude, when it is more then the Colatitude.

1 *An Example for finding the time of the Sun rising.*

If the Declination be 13 deg. looke for it in the annexed Tangent, and just against it in the houre Scale stands 16 deg. 53′ the ascentional difference in time 1 houre 7 ½ min. shewing that the Sun riseth so much before, and setteth so much after 6 in Summer, and in Winter riseth so much after, and setteth before 6, for this arke may be found on either side of six where the declination begins each way.

2. *To find the time of the day.*

To perform this Proposition wee divide the other Proportion into two, by introducing the Radius in the Middle.

As the Radius is to the Secant of the Declination.

So is the sine of the altitude to a fourth.

Again.

As the Cosine of the Latitude to Radius.

So the fourth before found.

To the difference of the Versed Sines of the Semidiurnal arke, and of the houre sought.

The former of these Proportions must be wrought upon the quadrant, the latter is removed by fitting the Radius of the Sines that gives the answer, equal in length to the Cosine of the latitude.

Wherefore to find the time of the day, lay the thread to the Secant of the declination in the limbe, and from the sine of the altitude take the nearest distance to it, and because the Secant is

made

made, but to halfe the Common Radius, set downe one foot of this extent at the Declination in the annexed Tangent, and enter the said extent twice forward, and it will shew the time of the Day.

Example.

Let the Declination be supposed 23 deg. 31′ North, and the Altitude 38 deg. 59′ the nearest distance from the Sine thereof, to the thread laid over the Secant of 32 deg. 31′ will reach being turned twice over from 32 d. 31′ in the annexed Tangent neerest the Center to 33 deg. 45′ in the Sines, *alias* to 56 d. 15′ counted as a Versed Sine shewing the time of the day to be a quarter past 8 in the morning, or three quarters past three in the afternoon.

3 *To find the Suns Altitude on all houres.*

Take the distance between the houre and the Declination in the fitted Scale, and enter it downe, the line of Sines from the Center, then laying the thread over the Cosine of the Declination in the Limbe, the nearest distance to it shall be the sine of the Altitude sought.

Example.

Thus whee the Sun hath 13 deg. of South Declination, count it in that part of the annexed Tangent nearest the Limbe, if then it were required to find the Suns Altit. for the houres of 10 or 2 by the former Prescriptions the Altitude would be found 10 d. 25′

4 *To find the Suns Amplitude.*

Take the Sine of the Declination from the line of the Sines, and apply it to the fitted Scale where the annexed Tangent begins, and either way it will reach to the Sine of the Amplitude.

Example.

So when the Sun hath 15 deg: of Declination his Amplitude will be found to be 24 deg. 35′.

5 To

5 *To find the Azimuth or true Coast of the Sun.*

Here we likewise introduce the Radius in the latter Proportion.

1 In Winter lay the thread to the Secant of the Altitude in the Limbe, and from the sine of the Declination, take the nearest distance to it, the said extent enter twice forward from the Altitude in the annexed Tangent, and it will reach to the Versed Sine of the Azimuth from the South.

Example.

So when the Sun hath 15 deg. of South Declination, if his Altitude be 15 deg. the nearest distance from the sine thereof to the thread laid over the Secant of 15 degrees, shall reach in the fitted Scale from the annexed Tangent of 15 deg. being twice repeated forward to the Versed sine of 39 deg. 50′ for the Suns Azimuth from the South.

2 In Summer when the Altitude is lesse then 40 deg. enter the former extent from the sine of the Declination to the thread laid over the Secant of the Altitude twice backward from the Altitude in the annexed Tangent, and it will reach to the Versed sine of the Azimuth from the South.

Example.

So if the Sun have 15 deg. of North Declination, and his Altitude be 30 deg. the prescribed extent doubled shall reach from the annexed Tangent of 30 deg. to the Versed sine of 75 deg. 44′ for the Suns Azimuth from the South.

3 In Summer when the Altitude is more then 40 deg. and lesse then 60 deg. apply the extent from the sine of the Declination to the thread, laid over the Secant of the Altitude, once to the Discontinued Tangent placed a Crosse the quadrant from the Altitude backwards minding how farre it reaches, just against the

like arke in the annexed Tangent stands the Versed sine of the Azimuth from the South.

4 When the Altitude is more then 60 deg. this fitted Scale is of worst performance, however the defect of the Secant might be supplyed by Varying the Proportion.

6 *To find the Suns Altitude on all Azimuths.*

Just against the Azimuth proposed stands the Suns altitude in the Equator suitable thereto, which was the first Arke found by Calculation when we treated of this subject, and the second arke is to be found by a Proportion in sines wrought upon the quadrant.

This quadrant is also particularly fitted for giving the houre, and Azimuth in the equal limbe.

The sine of 90 deg. made equal to the sine if 51 deg. 32′ gives the altitude of the Sun or Stars at six, for if the thread be laid over the Declination counted in the said sine, it shewes the Altitude sought in the limbe, so when the Sun hath 13 deg. of Declination his Altitude or Depression at 6 is 10 deg. 9′.

It also gives the Vertical Altitude if the Declination be counted in the limbe, seeke what arke it cuts in that particular sine, when the Sun hath 13 deg. of Declination, his Vertical Altitude or Depression is 16 deg. 42′.

To find the houre of the Day.

Having found the Altitude of the Sun or Stars at six, take the distance between the sine thereof in the line of Sines, and the Altitude given, and entring one foot of that extent at the Declination in the Scale of entrance laying the thread to the other foot according to nearest distance, it will shew the houre from six in the limbe.

Example.

When the Sun hath 13 deg. of Declination his Altitude, or

De-

Depression at six will be 10 deg. 9′ if the Declination be North, and the Altitude of the Sun be 24 deg. 5′ the time of the day will be halfe an houre past 7 in the morning, or as much past 4 in the afternoon.

In winter when the Sun hath South Declination as also for such Stars as have South Declination, the sine of their Altitude must be added to the sine of their Depression at six, and that whole extent entred as before.

When the Sun hath the same South Declination, if his Altitude be 11 deg. 7′ the time of the day will be half an houre past 8 in the morning, or 30 min. past 3 in the afternoon.

To find the Azimuth of the Sun or Stars.

LAy the thread over their Altitude in the particular sine fitted to the Latitude, and in the equal Limbe it shewes a fourth Arke.

When the Declination is North, take the distance in the line of Sines between that fourth Arke and the Declination, and enter one foot of that extent at the Altitude in the Scale of entrance, laying the thread to the other foot, and in the equal Limbe it shewes the Azimuth from the East or West.

Example.

When the Altitude is 44 deg. 39′ the Arch found in the equal Limbe will be 33 deg. 20′ then if the Declination be 23 deg 31′ North, the distance in the line of sines between it and the said Arke being entred at 44 deg. 39′ in the Scale of entrance the thread being laid to the other foot will shew the Azimuth to be 20 deg. from the East or West.

But if the Declination be South, adde with your Compasses the sine thereof to the sine of the fourth Arke, and enter that whole extent as before, and the thread will shew the Azimuth in the equal limbe.

Example. When the Altitude is. 12 d. 13′ the fourth Arch will be found to be 9 degrees 32 minutes, then admit the Declination to be 13 degrees South, whereto adding the Sine of the fourth Arke, the whole will be equall to the sine of 22 deg. 41 minutes, and this whole extent being entred at 12 deg. 13′ in the Scale of entrance lay the thread to the other foot according to nearest distance, and it will intersect the equal Limbe at 40 deg. and so much is the Suns Azimuth from the East or West.

Because the Scale of entrance could not be continued by reason of the Projection, the residue of it is put on an little Line neare the Amanack the use whereof is to lay the thread to the Altitude in it when the Azimuth is sought, and in the Limbe it shewes at what Arke of the Sines the point of entrance will happen which may likewise be found by pricking downe the Co-altitude on the line of Sines out of the fitted houre Scale on the right edge.

How to find the houre and Azimuth generally in the equal limb either with or without Tangents or Secants hath been also shewed, and how that those two points for any Latitude might be there prickt and might be taken off, either from the Limbe, or from a line of Sines, or best of all by Tables, for halfe the natural Tangent of the Latitude of *London*, is equal to the sine of 39 deg. And half the Secant thereof equal to the sine of 53 d. 30 Against which Arkes of the Limbe the Tangent and Secant of the Latitude are graduated, but of this enough hath been said in the Description of the small quadrant.

Of the Quadrat and Shadowes.

THe use thereof is the same as in the small quadrant onely if the thread hang over any degree of the Limb lesse then 45d. to take out the Tangent thereof out of the quadrat count the Arch from the right edge of the quadrant towards the left, and lay the thread over it, the pricks are repeated in the Limbe to save this trouble for those eminent parts.

Of the equal Limbe.

WE have before shewed that a Sine, Tangent and Secant may be taken off from it, and that having a Sine or Secant with the Radius thereof the correspondent Arke thereto might be found, & that a Chord might be taken off from Concentrick Circles or by helpe of a Bead, but if both be wanting enter the Semidiameter or

Radius

Radius whereto you would take out a Chord twice downe the right edge from the Center, and laying the thread over halfe the and laying the thread over halfe the Arch proposed, take the nearest distance to it, and thus may a chordbe taken out to any number of degrees lesse then a Semicircle.

It hath been asserted also that the houre and Azimuth might be found generally without Protraction by the sole helpe of the Limb with Compasses and a thread.

Example for finding the houre.

THe first work will be to find the point of entrance take out the Cosine of the Latitude by taking the nearest distance to the thread laid over the said Arke from the concurrence of the Limbe with the right edge, and enter it down the right edge line and take the nearest distance to the thread laid over the complement of the Declination counted from the right edge, this extent entred down the right edge finds the point of entrance, let it be noted with a mark. Next to find the sine point take out the sine of the Declin. & enter it dowh the right edge, & from the point of termination, take the nearest distance to the thread laid over the ark of the Latit. counted from the right edge, this extent enter from the Center and it finds the sine point, let it be noted with a marke.

Thirdly, take out the sine of the Altitude & in Winter add it in lenght to the sine point, in Summer enter it from the Center & take the distance between it & the sine point, which extent entred upon the point of entrance & if the thread be laid to the other foot shewes the the houre from 6 in the equal limb before or after it, as the Sine of the Altitude fell short or beyond the sine point.

Example. In the latitude of 39 d. the Sun having 23 d. 31′ of North Declination, and Altitude 51 deg. 32′ the houre will be found to be 33 deg. 45′ from six towards noon.

Note the point of entrance and sine point Vary not, till the Declination Vary.

After the same manner may the Azimuth be found in the limb, by proportions delivered in the other great quadrant. Also both or any angle when three sides are given may be found by the last general Proportion in the small quadrant which finds the halfe Versed sine of the Arke sought, which would be too tedious to insist upon & are more proper to be Protracted with a line of Chords.

To find the Azimuth universally.

THe Proportion used on the sinal quadrant for finding it in the equal limbe (wherein the first Operation for the Vertical Altitude was fixed for one day,) by reason of its Excursions will not serve on a quadrant, for the Sun or Stars when they come to the Meridian between the Zenith and the elevated Pole, but the Proportion there used for finding the houre applyed to other sides will serve for the Azimuth Universally, and that is

As the Radius, Is to the sine of the Latitude,
So is the sine of the Altitude,
To a fourth sine.

Again.

As the Cosine of the Altitude,
Is the Secant of the Latitude.

Or,

As the Cosine of the Latitude,
Is the Secant of the Altitude.

So In Declinations towards the Elevated Pole is the difference, but towards the Depressed Pole the summe of the fourth sine, and of the sine sine of the Declination.

To the sine of the Azimuth from the Vertical.

In Declinations towards the Depressed Pole, the Azimuth is alwayes obtuse, towards the elevated Pole if the Declination be more then the fourth Arch it is acute, if lesse obtuse.

Example for the Latitude of the Barbados 13 deg.

Altitude 27 deg. 27′.
Declination 20 deg. North.

Lay the thread to 27 deg. 27′ in the Limbe, and from the sine of 13 deg. take nearest distance to it which enter on the line of Sines from the Center, and take the distance between the limited point, and the sine of 20 deg. the Declination, this latter extent enter twice downe the line of the Sines from the Center,

and

and take the nearest distance to the thread laid over the Secant of 27 deg. 27′ this extent enter at the sine of 77 deg. the Complement of the Latitude, and laying the thread to the other foot it will lye over 16 deg. in the equal Limbe, the Suns Azimuth to the Northwards of the East or West.

Otherwaies.

Another Example for the same Latitude and Declination, the Altitude being 52 deg. 27′ lay the thread to it in the Limbe, and take the nearest distance to it from the sine of 13 deg. as before, and enter it downe the line of sines from the Center, and from the point of the limitation take the distance to the sine of 20 deg. the Suns Declination, this latter extent enter once downe the line of sines from the Center, and take the nearest distance to the Thread laid over the Secant of the Altitude 52 deg. 27′ then lay the thread to 77 deg. the Complement of the Latitude in the lesser sines, and enter the former extent between the Scale and the thread, and the foot of the Compasses sheweth 16 deg. as before, for the Suns Azimuth to the Northward of the Vertical, that the Sun may have the same Azimuth, upon two several Altitudes hath been spoken to before, and how to do this without Secants hath been shewne.

Two sides with the Angle comprehended to find the third side.

Divers wayes have been shewed for doing of this before, I shall adde one more requiring no Versed sines nor Tangents.

1 If both the sides be lesser then quadrants, and the Angle at liberty.

Or,

2 If one of the sides be greater then a quadrant, and the Angle included acute, it will hold.

As the Radius, To the Cosine of one of the including sines.

So is the Cosine of the other, To a fourth sine.

Again

Again.

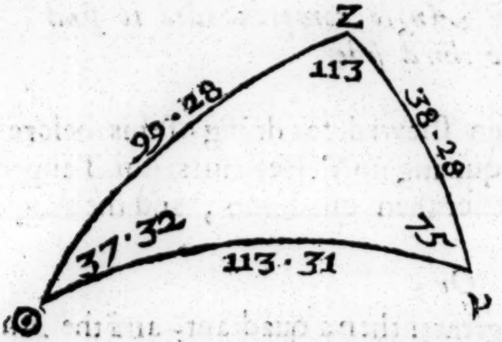
As the Cosecant of one of the including Sides
So is the Sine of the other,
So is the Cosine of the angle included,
To a seventh Sine.

The difference between the fourth and the seventh Sine, is the Cosine of the Side sought.

1 In the first case if the angle given be obtuse, and the seventh Sine greater then the fourth Sine, the Side sought is greater then a quadrant in other cases lesse.

If in the second case the seventh Sine be lesse then the fourth, the side sought is greater then a quadrant in other cases lesse.

In this second case when one of the includers is greater then a quadrant, and the angle obtuse resolve the opposite Triangle by the former Rules, or the summe of the fourth and seventh Sine shall be the Cosine of the side sought in this case greater then a quadrant. We have before noted that the Cosine of an Arke greater then a quadrant is the Sine of that Arkes excesse above 90 deg. this no other then the converse of the Proportion for the houre demonstrated from the Analemma, in the Triangle O Z P.



Let there be given the Sides O P 113 deg. 31′ the side Z P 38 deg. 28′ and the angle comprehended Z P O 75 to find the Side O Z.

Operation.

Lay the thread to 52 deg. 32′ in the Limbe, and from 13 deg. 31′ in

in the Sines take the nearest distance to it which measured from the Center will reach to the sine of 18 deg. 12 minutes the fourth Sine.

Again, laying the thread to 23 deg. 31′ in the Limbe, from the Sine of 15 deg. take the nearest distance to it, then lay the thread to the Secant of 51 deg. 32′ and enter the said extent between the Scale and the thread, the distance between the resting foot, and the Sine of 18 deg. 12 minutes before found measured from the Center is equal to the Sine of 9 deg. 32′ being the Cosine of the side sought which in this instance because the seventh Sine is lesse then the fourth sine is greater then a quadrant, and consequently must have 90 deg. added thereto, therefore the side O Z is 99 deg. 28 minutes if the question had been put in this Latitude what depression the Sun should have had under the Horizon at the houres of 5 or 7 in the Winter Tropick it would have been found 9 deg. 28′ and this is such a Triangle as hath but one obtuse Angle yet two sides greater then quadrants, and how to shunne a Secant, and a parallel entrance hath been shewed else-where.

Of the Stars on the Projection, and in other places of the fore-side of the quadrant.

SUch only are placed on the Projection as fall between the Tropicks being put an according to their true Declinations, and in that respect might have stood any where in the parallel of Declination, but in regard we shall also find the time of the night by them with Compasses, they are also put on in a certain Angle from the right edge of the quadrant, to find the quantity of the Angle for Stars of Northerly declination, get the difference of the Sines of the Stars Altitude six houres from the Meridian, and of its Meridian Altitude, and find to the Sine of what Arch the said difference is equal, against that Arch in the Limbe, let the Star be graduated in its proper declination, but for Stars of Southwardly Declination, get the summe of the Sines of their Depression at six and of their Meridian Altitude, and find what Arke in the Sines corresponds thereto as before.

We have put on no Stars of Southwardly Declination that will fall beyond the Winter Tropick, but some of Northerly Declination falling without the Summer Tropick, are put on that are

placed without the Projection towards the Limbe.

All these Stars must be graduated against the line of Sines at their respective Altitudes or Depressions at the Stars houre of Six from the Meridian, and must have the same letter set to them in both places, as also upon the quadrant of 12 houres of Ascension on the Back-side where they are put on according to their true Ascension with their Declinations and Ascensional differences graved against them with the former Letter, and such of them as have more then 12 houres of right Ascension have the Character *plus* + affixed, denoting that if there be 12 houres of Ascension added to that Ascension they stand against, the summe is their whole true right Ascension.

To find the quantity of a Stars houre from the Meridian by the Projection.

SEt the Bead upon the Index of Altitude to the Stars observed Altitude, and bring it to the parallel of Declination the Star is graved in, so will it shew among the houre lines, that Stars houre from the Meridian, and the thread in the Limbe will shew the Stars Azimuth.

Example.

Admit the Altitude of *Arcturus* be 52 deg. the houre of that Star from midnight, if the Altitude increase will be 7′ past 10 *fere*, and the Azimuth of that Star will be 47 deg. 43′ to the Eastwards of the South.

The houre and Azimuth of any Star within the Tropicks, may be also found by the fitted Scale on the right edge of the quadrant, or by the Curve, after the same manner as for the Sun, using the Stars Declination as was done for the Suns, or in the equall limb as we shewed for the Sun, which may well serve for most of the Stars in the Hemisphere.

Otherwise with Compasses according to the late suggested placing of them.

To find the houre of any Star from the Meridian that hath North Declination.

TAke the distance between the Star point in the line of Sines, and its observed Altitude, and laying the thread over the Star where it is graved on or below the Projection, enter the former extent paralelly between the thread and the Scale, and it shewes the Stars houre from six in the sines towards noone, if the Altitude fell beyond the Star point, otherwise towards midnight.

Example.

For the Goat Star let its Altitude be 40 deg. and past the Meridian, the houre of that Star will be 44′ from six, for the Compasses fall upon the sine of 11 deg. 4′ the houre is towards noon Meridian, because the Altitude is greater then 34 deg. the point where the Star is graved, the thread lying over the Star intersects, the Limbe at 25 deg. 47′ if the distance between the Star, and its Altitude be entred at the sine of that Arke, and the thread laid to the other foot, the houre will be found in the equal Limbe the same as before.

For Stars of Southwardly Declination.

BEcause the Star point cannot fall the other way beyond the Center of the quadrant, therefore the distance between the Star point, and the Center must be increasing by adding the sine of the Stars Altitude thereto, which will fall more outwards towards the Limbe, and then that whole extent is to be entred as before.

Example.

The *Virgins Spike* hath 9 deg. 19′ of South Declination the Depression of that Star at six will be found by help of the particular sine to be 7 deg. 17′ and at that Arke in the sines the Star is graved, if the Altitude of that Star were 20 deg. the sine thereof added to the Star will be equal to the sine of 29 deg. 6′ this whole

extent entred at the ſine of 37 deg. 52′ the Arke of the Limbe againſt which the Star is graved, and the thread laid to the other foot, the houre of that Star if the Altitude increaſe will be 19′ paſt 9.

To *find the true time of the night.*

THis muſt be done by turning the Stars houre into the Suns houre or common time, either by the Pen as hath been ſhewed before, which may be alſo conveniently performed by the back of this quadrant, for the thread lying over the day of the moneth ſheweth the Complement of the Suns Aſcenſion in the Limbe.

Or with Compaſſes on the ſaid quadrant of Aſcenſions.

THe thread lying over the day of the moneth, take the diſtance between it and the Star on the ſaid quadrant, the ſaid extent being applyed, the ſame way as it was taken the Suns foot to the Stars houre ſhall reach from the Stars houre to the true houre of the night, and if one of the feet of the Compaſſes fall oft the quadrant, a double remedy is elſ-where preſcribed.

Example.

If on the 12th of *January* the houre of the *Goat Star* was 16′ paſt 5 from the Meridian, the true time ſought would be 49′ paſt 1 in the morning.

Example.

If upon the third of *January*, the houre of the *Virgins Spike*, were obſerved to be 19′ paſt 9, the true time ſought would be 45′ paſt 2 in the morning.

To find the time of a Stars rising and setting.

THe Ascentional difference is graved against the Star, the *Virgins Spike* hath 48′ of Ascentional difference, that is to say, that Stars houre of rising is at 48′ past 6, and setting at 12′ past 5, And the true time of that Stars rising upon the third of *January*, will be at 23′ past 10 at night, and of its setting at 47′ past 8 in the morning, found by the former directions.

Of the rest of the lines on the back of this quadrant.

THey are either such as relate to the motion of the Sun or Stars, or to Dialling, or such as are derived from Mr *Gunters* Sector.

The Tangent of 51 deg. 32′ put through the whole Limbe is peculiarly fitted to the Latitude of *London*, and will serve to find the time when the Sun will be East or West, as also for any of the Stars that have lesse Declination then the place hath Latitude.

Lay the thread to the Declination counted in the said Tangent, and in the Limbe it shewes the houre from 6 if reckoned from the right edge.

Example.

When the Sun hath 15 deg. of North Declination the time of his being East or West will be 12 deg. 17′ in time about 49′ before or after six, *ferè*.

The Suns place is given in the Ecliptick line by laying the thread over the day of the moneth in the quadrant of Ascensions, of which see *page* 16 & 17 of the small quadrant.

Of the lines relating to Dialling.

SUch are the Line of Latitudes, and Scale of houres, of which before, and the line Sol in the Limbe, of which I shall say nothing at present, it is onely placed there in readinesse to take off any Arke from it, according to the accustomed manner of taking off lines from the Limbe to any assigned Radius.

The

The requisite Arkes of an upright Decliner will be given by the particular lines on the Quadrant for the Latitude without the trouble of Proportionall worke.

1. *The substiles distance from the Meridian.*

ACcount the Plaines declination as a sine in the fitted hour Scale on the right edge of the fore-side, and just against it in the annexed Tangent, stands the substiles distance from the meridian.

If an upright Plaine decline 30 deg. the substiles distance will be 23 deg. 41 minutes.

2. *The Stiles height.*

Count the Complement of the Plaines Declination in the said fitted houre scale as a sine and apply it with Compasses to the line of sines issuing from the Center, for the former Plaine the stiles height will be found 32 deg. 37′.

3. *The Inclination of Meridians.*

Account the stiles height in the annexed tangent of the fitted hour Scale, and just against it in the sine stands the Complement of the Inclination of meridians which for the former plaine will be found to be 36 deg. 25′.

4. *The Angle of 12 and 6.*

Account the Plaines Declination in the Limbe on the Backside from the right edge, and lay the thread over it, and in the particular Tangent it shewes the Angle between the Horison and six 32 deg. 9′ in this Example the Complement whereof is the Angle of 12 and 6, namely 57 deg. 51 min.

Also

Also the requisite Arkes of a direct East or West, reclining or inclining Dial may be found after the same manner for this Latit.

1 The substiles distance.

ACcount the Plaines Reclination in the Limbe on the Backside from the left edge, and in there lay the thread, and in the particular Tangent it shewes the Arke sought.

So if an East or West plain recline or incline 60 deg. the substiles distance will be found to be 32 deg. 12′.

2 The stiles height.

Account the Reclination in the particular Sine on the foreside and in the Limbe it shewes the stiles height, which for the former Example will be found to be 42 deg. 41′.

3 The inclination of Meridians.

The Proportion is, As the Sine of the Latitude, to Radius.

So is the sine of the substiles distance.

To the sine of the inclination of Meridians, when the substiles distance is lesse then the Latitude of the place it may be found in the particular sine on the foreside, by the intersection of the thread, and for this Example will be 42 deg. 53′.

4 The Angle of 12 and 6.

Account the Complement of the Reclination in the peculiar hour Scale as a sine, and just against it in the annexed Tangent stands the Complement of the Angle sought, in this Example the Angle of 12 and 6 is 68 deg. 20′.

In other Latitudes the Operations must be performed by Proportional worke with the Compasses.

Of

Of the Lines derived from Mr. Gunters Sector.

Such are the Lines of superficies Solids, &c.

Of the Line of Superficies or Squares.

THe chiefe uses of this Line joyntly with the Line of Lines in the Limbe, is when a square number is given to find the Root thereof, or a Root given to find the square number thereto, these Lines placed on a quadrant will perform this some what better then a Sector, because it is given by the Intersection of the thread without Compasses, the properties of the quadrant casting these lines large where on a Sector they would be narrow.

To find the square Root of a number.

The Root being given to find the Square Number of that Root.

IN extracting the square Root pricks must be set under the first third, fift, and seventh figure, and so forward and as many pricks as fall to be under the square number given, so many figures shall be in the Root, and accordingly the line of lines, and superficies must vary in the number they represent, I am very unwilling to spend any time about these kind of Lines, as being of small performance, and by my self and almost by all men accounted meere toyes.

If a number be given in the superficies, the thread in the lines sheweth the Root of it, and the contrary, if a number be given in the lines the thread laid over it intersects the Square thereof.

The performance thereof by these lines is so deficient that I shall give no Example of it.

When a number is given to find the square thereof, if not to large the Reader may correct the last figure of it by multiplying it in his memory.

To

To three numbers given to find a fourth in a Duplicated Proportion.

That is to worke a Proportion between Numbers and Squares?

Example.

If the Diameter of a Circle whose *Area* is 154 be 14, what shall the Diameter of that Circle be whose *Area* is 616.

Example.

Lay the thread over 616 in the superficies, and from 14 in the equal parts, take the nearest distance to it, then lay the thread to 154 in the superficies, and enter the former extent between the thread and the Scale, and the foot of the Compasses will rest upon 28 the diameter sought.

To find a Proportion between two or more like superficies.

ADmit there be two Circles, and I would know what Proportion their *Areas* bear to each other, in this case the proper use of a Line of superficies would be to have it on a ruler, and to measure the lengths of their like sides, for Circles the lengths of their Diameters upon it, and then I say, the numbers found on the superficies beare such Proportion each to other as the *Areas* or superficial contents, and for small quantities may be done on the quadrant by entring downe the larger extent of the Compasses on the Line of Lines from the Center, and mind the point of limitation, enter then the other extent on the point of limitation, and lay the thread to the other foot, find what number it cuts in the superficies, and the greater shall beare such Proportion to the lesser as 100, &c. the length of the whole line doth to the parts cut.

The Proportion that two superficies beare each to other is the same that the squares of their like sides, and therefore their sides may be measured either in foot or inch measure, and then the Squares taken out as before shewed.

The line of superficies serves for the reducing of Plots to any proportion.

ADmit a Plot of a piece of ground being cast up containes 364 Acres, and it were required to draw another Plot which being cast up by the same Scale should containe but a quarter so much, and let one side of the said Plot be 60 inches, against 60 in the lines, the square of it will be found to be 3600, and the fourth part hereof would be 900, which account in the superficies and you will find the Square Root of it to be 30, and so many inches must be the like side of the lesser Plot if being cast up by the same Scale it should containe but $\frac{1}{4}$ of what it did before.

If the line of Superficies were on a streight ruler, then to perform such a Proposition as this, would be to measure therewith the side of the Plot given, minding what number it reaches to in the Superficies, the fourth part of the said Number being reckoned on the Superficies, and thence taken shall be the length of the side in the Proportion required.

Of the Line of Solids.

IF a number be duly estimated in the said line, and the thread laid over it, it will in the line of lines shew the cube Root of that number, and the converse the Root being assigned, the Cube may be found, but by reason of the sorry performance of these Lines I shall spend no time about it, if this line be placed on a loose Ruler, and the like sides of two like Solids be measured therewith, those Solids shall beare such Proportion in their contents each to other as the measured lengths on the Solids.

Three Numbers being given to find the fourth in a Duplicated Proportion.

Example.

IF a Bullet of 4 inches Diameter weigh 9 pound, what shall a Bullet of 8 inches Diameter weigh? Answer 72 pounds.

In-

In this case let the whole line of Solids represent 100, alwayes the Solid content whether given or sought, must be accounted in the line of Solids, and the Sides or Diameters in the Equall parts.

Lay the thread to 9 in the line of Solids, and from 8 in the inches take the nearest distance to it, enter one foot of that extent at 4 in the inches, and lay the thread to the other foot: and it will lye over 72 in the Solids for the weight of the Bullet sought.

An Example of the Converse.

If a Bullet whose Diameter is 4 Inches weigh 9 pound, another Bullet whose weight is 40 pound, what shall be the Diameter of it.

Lay the thread to 40 in the Solids, and from 4 Inches in the lines take the nearest distance to it.

Then lay the thread to 9 in the Solids, and enter the said extent at the equal Scale, so that the other foot turned about may but just touch the thread, and it it will rest at $6\frac{1}{2}$ Inches nearest, which is the Diameter sought.

Of the Line of inscribed Bodies.

This Line hath these letters set to it.

D	Signifying the Sides of a	*Dodecahedron*
S		
I		*Icosahedron*
C		*Cube*
O		*Octohedron*
T		*Tetrahedron*

And the Letter S Signifieth the Semidiameter of a Sphere, the use whereof are to find the Sides of the five Regular Bodies that may be inscribed in a Sphere.

Example.

A joyner being to cut the 5 Regular Bodies desires to know the lengths of the sides of the said 5 Regular Bodies that may be inscribed in a Sphere where Diameter is 6 inches.

Lay the thread over S and take 3 inches out of the line of equal parts or Inches, and enter that extent so that one foot resting on the said Scale of inches, the other turned about may but just touch the thread, the resting point thus found, I call the point of entrance, from the said point take the nearest distances to the thread laid over the Letters.

		Inch.	Dec. parts
D	*And measure those Extents on the Line of Inches, and you will find them to reach to.*	2	.13
I		3	.15
C		3	.45
O		4	.23
T		4	.86

Which are the Dimensions of the respective sides of those Bodies to which the Letters belong.

The uses of the Lines of quadrature, Segments, Mettals and Equated Bodies, I leave to the Disquisition of the *Reader*, when he shall have occasion to put them in practice, which I think will be seldome or never, and wherein the assistance of the Pen will be more commendable.

These lines were added to this quadrant to fill up spare room, and to shew that what ever can be done on the Sector, may be performed by them on a quadrant.

A TABLE

Of the Latitude of the most eminent Places in *England*, *Wales*, *Scotland* and *Ireland*.

	d.	m.		d.	m.
Bedford	52	8	*Reading*	51	28
Barwick	55	54	*Salisbury*	51	4
Bristol	51	27	*Shrewsbery*	52	47
Buckingham	52		*Stafford*	52	52
Cambridge	52	12	*Stamford*	52	38
Canterbury	51	17	*Truero*	50	30
Carlisle	55		*Warwick*	52	20
Chichester	50	48	*Winchester*	51	3
Chester	53	16	*Worcester*	52	14
Colchester	51	58	*Yorke.*	53	58
Derby	52	58			
Dorchester	50	40	WALES	d.	m.
Durham	54	50	*Anglezey*	53	28
Exceter	50	43	*Barmouth*	52	50
Gilford	51	12	*Brecknock*	52	1
Gloucester	51	53	*Cardigan*	52	12
Hartford	51	49	*Carmarthen*	51	56
Hereford	52	7	*Carnarvan*	53	16
Huntington	52	19	*Denbigh*	53	13
Ipswich	52	8	*Flint*	53	17
Kendal	54	23	*Llandaffe*	51	35
Lancaster	54	10	*Monmouth*	51	51
Leicester	52	40	*Montgomeroy*	51	56
Lincolne	53	14	*Pembrooke*	51	46
London	51	32	*Radnor*	52	19
Northampton	52	14	*St. David.*	52	00
Norwich	52	42			
Nottingham	53		The ISLANDS.	d.	m
Oxford	51	46	*Garnzey*	49	30

	d.	m.
Jersey	49	12
Lundy	51	22
Man.	54	24
Portland	50	33
Wight Isle.	50	39
SCOTLAND.	**d.**	**m.**
Aberdean	57	32
Dunblain	56	21
Dunkel	56	48
Edinburgh	55	56
Glascow	55	52
Kintaile	57	44
Orkney Isle	60	6
St. Andrewes	56	39
Skirassin	58	36
Sterling.	56	12
IRELAND.	**d.**	**m.**
Antrim	54	38
Arglas	54	10
Armach	54	14
Caterlagh	52	41
Clare	52	34
Corke	51	53
Droghedah	53	38
Dublin	53	13
Dundalk	53	52
Galloway	53	2
Youghal	51	53
Kenny	52	27
Kildare	53	00
Kings towne	53	8
Knock fergus	54	37
Kynsale	51	41
Lymerick	52	30
Queens towne	52	52
Waterford	52	9
Wexford.	52	18

A Table of the right Ascensions and Declinations of some of the most principal fixed Stars for some yeares to come.

	R. Ascension.		*Declination.*			*Magnitude*
	H	m	D.	m.		
Pole Star	00	31	87	34	N	2
Andromedas Girdle	00	50	33	50	N	2
Whales Belly	01	35	12		S	3
Rams head	1	48	21	49	N	3
Whales mouth	2	44	2	42	N	2
Medusas head	2	46	39	35	N	3
Perseus right side	2	59	48	38	N	2
Buls eye	4	16	15	46	N	1
Goat	4	52	45	37	N	1
Orions left foot	4	58	8	38	S	1
Orions left shoulder	5	6	5	59	N	3
First, in Orions girdle	5	15	00	35	S	3
Second, in Orions girdle	5	19	1	27	S	3
Third, in Orions girdle	5	23	2	9	S	3
Orions right shoulder	5	36	7	18	N	2
The Wagoner	5	39	44	56	N	2
Bright foot of the Twins	6	18	16	39	N	3
Great Dog	6	30	16	13	S	1
Castor or Apollo	7	12	32	30	N	2
The little Dog	7	22	6	6	N	2
Pollux or Hercules	7	24	28	48	N	2
Hidra's heart	9	10	7	10	S	1
Lions heart	9	50	13	39	N	1
Lions Neck	9	50	21	41	N	3
Great Beares rump	10	40	58	43	N	2
Lions back	11	30	22	4	N	2
Lions tail	11	31	16	30	N	1
The Virgins girdle	12	38	5	20	N	3
First in the great Bears taile next the rump	12	38	57	51	N	2
Vindemiatrix	12	44	15	51	N	3
Virgins Spike	13	7	9	19	S	1

Middle-

Names.	*R. Ascension.* H	m	*Declination.* D.	m.		*Magnitude*
Middlemost in the Great Beares tail	13	10	56	45	N	2
Last in the end of the Great Beares tail	13	34	51	05	N	2
Arcturus	14	00	21	03	N	1
South Ballance	14	32	14	33	S	2
Brightest in the Crown	15	24	27	43	N	3
North Ballance	14	58	08	03	S	3
Serpentaries left hand	15	56	02	46	S	3
Scorpions heart	16	08	25	35	S	1
Serpentaries left knee	16	18	09	46	S	3
Serpentaries right knee	16	49	15	12	S	3
Hercules head	16	59	14	51	N	3
Serpentaries head	17	19	12	52	N	3
Dragons head	17	48	51	36	N	3
Brightest in the Harp	18	25	38	30	N	1
Eagle or Vultures heart	19	34	08	00	N	2
Upper horn of Capricorn	19	58	13	32	S	3
Swans tail	20	30	44	05	N	2
Left shoulder of Aquarius	21	13	07	02	S	3
Pegasus mouth	21	27	08	19	N	3
Right shoulder of Aquarius	21	48	01	58	S	3
Fomahant	22	39	31	17	S	1
Pegasus upper Wing, or *Marchab*	22	48	13	21	N	2
Pegasus Lower Wing.	23	55	33	25	N	2

Mr. Sutton knowing that ſome of the Tables of *Declination* and *Right Aſcenſion* in our *Engliſh Books* are antiquated and removed forward, took the pains to Calculate a new Table of *Right Aſcenſions* and *Declinations* to ſerve for the future, in regard I was not at leiſure to accompliſh it; which followeth.

A Table of the Suns Right Ascension and

Dayes.	January ☉ R. A. H.	☉ R. A. M.	☉ Decl. D.	☉ Decl. M.	February ☉ R. A. H.	☉ R. A. M.	☉ Decl. D.	☉ Decl. M.	March ☉ R. A. H.	☉ R. A. M.	☉ Decl. D.	☉ Decl. M.
1	19	35	21	46	21	42	13	49	23	28	3	27
2	19	39	21	36	21	46	13	29	23	32	3	03
3	19	43	21	25	21	50	13	08	23	36	2	39
4	19	47	21	14	21	54	12	48	23	39	2	16
5	19	51	21	03	21	58	12	28	23	43	1	52
6	19	56	20	52	22	02	12	06	23	46	1	29
7	20	00	20	40	22	06	11	45	23	50	1	05
8	20	04	20	27	22	10	11	24	23	53	0	41
9	20	09	20	15	22	14	11	03	23	57	0	18
10	20	13	20	01	22	17	10	41	0	01	North	
11	20	17	19	48	22	21	10	19	0	05	0	30
12	20	22	19	34	22	25	9	57	0	08	0	53
13	20	26	19	20	22	29	9	35	0	12	1	17
14	20	30	19	05	22	33	9	13	0	15	1	41
15	20	34	18	50	22	36	8	51	0	19	2	04
16	20	38	18	35	22	40	8	26	0	23	2	28
17	20	42	18	19	22	44	8	06	0	26	2	51
18	20	46	18	03	22	48	7	43	0	30	3	15
19	20	50	17	47	22	52	7	20	0	33	3	38
20	20	54	17	30	22	55	6	57	0	37	4	01
21	20	58	17	13	22	59	6	34	0	41	4	24
22	21	03	16	56	23	03	6	11	0	44	4	48
23	21	07	16	39	23	06	5	48	0	48	5	11
24	21	11	16	21	23	10	5	24	0	52	5	34
25	21	15	16	03	23	13	5	01	0	55	5	57
26	21	19	15	44	23	17	4	37	0	59	6	19
27	21	23	15	26	23	21	4	14	1	03	6	42
28	21	27	15	07	23	25	3	51	1	06	7	04
29	21	31	14	48					1	10	7	27
30	21	35	14	28					1	14	7	49
31	21	38	14	09					1	17	8	11

Declination for the Year 1666.

Dayes.	April.				May				June.			
	⊙ R. A.		⊙ Decl.		⊙ R. A.		⊙ Decl.		⊙ R. A.		⊙ Decl.	
	H.	M.	D.	M.	H.	M.	D.	M.	H.	M.	D.	M.
1	1	21	8	33	3	14	18	03	5	19	23	11
2	1	25	8	55	3	18	18	18	5	23	23	15
3	1	29	9	17	3	22	18	33	5	27	23	19
4	1	33	9	38	3	26	18	48	5	31	23	22
5	1	36	9	51	3	30	19	02	5	36	23	24
6	1	40	10	21	3	34	19	16	5	40	23	26
7	1	44	10	42	3	38	19	29	5	44	23	28
8	1	47	11	03	3	42	19	42	5	48	23	29
9	1	51	11	24	3	46	19	55	5	52	23	30
10	1	54	11	44	3	50	20	08	5	56	23	31
11	1	58	12	05	3	54	20	20	6	00	23	31½
12	2	02	12	24	3	58	20	32	6	04	23	31
13	2	06	12	45	4	02	20	44	6	08	23	30
14	2	10	13	04	4	06	20	55	6	12	23	29
15	2	13	13	24	4	10	21	05	6	17	23	28
16	2	17	13	43	4	14	21	16	6	21	23	26
17	2	21	14	02	4	18	21	26	6	25	23	24
18	2	25	14	21	4	22	21	36	6	29	23	21
19	2	29	14	40	4	26	21	45	6	33	23	18
20	2	32	14	58	4	30	21	54	6	38	23	14
21	2	36	15	16	4	34	22	02	6	42	23	11
22	2	40	15	34	4	38	22	11	6	46	23	06
23	2	44	15	52	4	42	22	19	6	50	23	01
24	2	48	16	09	4	46	22	26	6	54	22	56
25	2	51	16	27	4	50	22	33	6	58	22	51
26	2	55	16	43	4	54	22	40	7	02	22	45
27	2	59	17	00	4	58	22	46	7	06	22	39
28	3	03	17	16	5	02	22	52	7	10	22	32
29	3	07	17	32	5	06	22	57	7	14	22	25
30	3	10	17	48	5	11	23	02	7	19	22	17
31					5	15	23	07				

Dayes	July ☉ R.A.		July ☉ Decl.		August ☉ R.A.		August ☉ Decl.		September ☉ R.A.		September ☉ Decl.	
	H.	M.	D.	M.	H.	M.	D.	M.	H.	M.	D.	M.
1	7	23	22	09	9	25	15	16	11	19	4	28
2	7	27	22	01	9	29	14	58	11	23	4	6
3	7	31	21	52	9	33	14	39	11	26	3	42
4	7	35	21	43	9	37	14	21	11	30	3	19
5	7	39	21	34	9	40	14	02	11	33	2	56
6	7	43	21	24	9	44	13	43	11	37	2	3[illegible]
7	7	47	21	14	9	48	13	24	11	41	2	10
8	7	51	21	04	9	51	13	04	11	44	1	46
9	7	55	20	53	9	55	12	45	11	48	1	23
10	7	59	20	42	9	58	12	25	11	51	0	59
11	8	03	20	30	10	02	12	05	11	55	0	36
12	8	07	20	18	10	06	11	45	11	59	0	12
13	8	11	20	06	10	10	11	25	12	02	South	11
14	8	15	19	54	10	14	11	04	12	06	0	35
15	8	19	19	41	10	17	10	43	12	09	0	58
16	8	23	19	28	10	21	10	22	12	13	1	22
17	8	27	19	14	10	25	10	01	12	17	1	46
18	8	31	19	00	10	28	9	40	12	20	2	09
19	8	35	18	46	10	32	9	18	12	24	2	33
20	8	39	18	32	10	35	8	57	12	27	2	56
21	8	43	18	17	10	39	8	35	12	31	3	19
22	8	47	18	02	10	43	8	14	12	35	3	43
23	8	51	17	46	10	46	7	52	12	38	4	06
24	8	55	17	31	10	50	7	30	12	42	4	30
25	8	58	17	15	10	53	7	07	12	45	4	53
26	9	02	16	59	10	57	6	45	12	49	5	16
27	9	06	16	42	11	01	6	22	12	53	5	39
28	9	10	16	25	11	04	6	00	12	57	6	02
29	9	14	16	08	11	08	5	37	13	01	6	26
30	9	17	15	51	11	11	5	14	13	04	6	49
31	9	21	15	33	11	15	4	51				

Declination for the Year 1666.

Dayes.	October ☉ R. A. H.	M.	☉ Decl. D.	M.	November ☉ R. A. H.	M.	☉ Decl. D.	M.	December. ☉ R. A. H.	M.	☉ Decl. D.	M.
1	13	08	7	11	15	07	17	38	17	15	23	08
2	13	12	7	34	15	11	17	54	17	20	23	13
3	13	15	7	57	15	15	18	10	17	25	23	17
4	13	19	8	19	15	19	18	26	17	29	23	20
5	13	22	8	42	15	23	18	41	17	34	23	23
6	13	26	9	04	15	27	18	56	17	38	23	26
7	13	30	9	26	15	31	19	11	17	42	23	28
8	13	34	9	48	15	36	19	26	17	47	23	29
9	13	38	10	10	15	40	19	40	17	51	23	30
10	13	41	10	31	15	45	19	53	17	56	23	31
11	13	45	10	53	15	49	20	07	18	00	23	31½
12	13	49	11	14	15	53	20	19	18	05	23	31
13	13	53	11	36	15	58	20	32	18	09	23	30
14	13	57	11	57	16	02	20	44	18	14	23	29
15	14	00	12	18	16	07	20	56	18	19	23	27
16	14	04	12	38	16	11	21	08	18	24	23	25
17	14	08	12	59	16	15	21	19	18	28	23	22
18	14	12	13	19	16	19	21	29	18	33	23	19
19	14	16	13	39	16	23	21	39	18	37	23	15
20	14	20	13	59	16	28	21	49	18	41	23	11
21	14	24	14	19	16	32	21	58	18	45	23	07
22	14	28	14	38	16	36	22	08	18	49	23	02
23	14	32	14	57	16	40	22	16	18	54	22	56
24	14	36	15	16	16	44	22	24	18	58	22	50
25	14	39	15	35	16	49	22	32	19	03	22	43
26	14	43	15	53	16	53	22	39	19	07	22	36
27	14	47	16	11	16	57	22	46	19	11	22	29
28	14	51	16	29	17	02	22	52	19	16	22	21
29	14	55	16	47	17	06	22	58	19	20	22	[illegible]
30	14	59	17	04	17	11	23	03	19	25	22	04
31	15	03	17	21					19	30	21	55

A Rectifying Table for the Suns Declination.

	Years		Years		Years	
	1657		1659		1660	
	1661		1663		1664	
	1665		1667		1668	
	1669		1671		1672	
	1673		1675		1676	
Moneths	*min.*		*min.*		*min.*	
January	3	s	2	a	5	a
	4	s	3	a	7	a
	5	s	4	a	9	a
February	5	s	5	a	10	a
	5	s	5	a	11	a
	6	s	5	a	11	a
March	6	s	5	a	13	s
	5	a	5	s	12	a
	5	a	5	s	12	a
April	5	a	5	s	11	a
	5	a	5	s	10	a
	4	a	4	s	9	a
May	4	a	4	s	8	a
	3	a	3	s	6	a
	2	a	2	s	4	a
June	1	a	1	s	2	a
	0	s	0	a	0	s
	1	s	1	a	3	s

	Years		Years		Years	
	1657		1659		1660	
	1661		1663		1664	
	1665		1667		1668	
	1669		1671		1672	
	1673		1675		1676	
Moneths	*min.*		*min.*		*min.*	
July	2	s	2	a	5	s
	3	s	3	a	7	s
	4	s	4	a	9	s
August.	5	s	5	a	10	s
	5	s	5	a	11	s
	6	s	5	a	12	s
Septēber	6	s	5	a	13	s
	6	a	5	s	13	a
	6	a	5	s	12	a
October	6	a	5	s	12	a
	5	a	5	s	11	a
	4	a	5	s	9	a
Novem.	3	a	4	s	7	a
	2	a	3	s	5	a
	1	a	2	s	3	a
Decemb.	0	a	1	s	1	a
	1	s	0	a	1	s
	2	s	1	a	3	s

The use of the Rectifying Table.

NOte that the minutes under the respective years is to be added or substracted to or from the Suns Declination in the former Table, as is noted with the letter a or s: and also note that the first figure in each moneth stands for the first 10 dayes of the moneth, and the second for the second 10 days, & the third for the last 10 dayes, except in *March* or *September*, which in *March* will be the first 9 dayes only, and in *September* the first 12 dayes.

Example.

I would know the Suns Declination the 15 day of *May* 1668. Now because this day of the moneth falls in the second 10 dayes, I look in the Table under the year 1668, and right against *May* you shall finde that in the second place of the moneth stands 6 a, which shews me that I must adde 6 minutes to the Suns Declination in the former Table 21 degrees 5 min. that stands against the 15 day of *May*, and then I find that the Sun will have 21 deg. 11 min. of North Declination, and so for the rest, which will never differ above two minutes from the truth, but seldome so much, and for the most part true.

Note that the former Table of the Suns Declination is fitted exactly for the year 1666. *by the Rules* Mr. Wright *gives in his* Correction of Errours, *and from his Tables, and may indifferently serve for the years* 1658, 1662. 1670, 1674, *without any sensible errour, and the* T*able of Right Ascensions will not vary a minute of time in many years.*

FINIS.

Errours in the Horizontal Quadrant.

PAge 5 line 6 in an Italian letter should not have been distinct, nor in another letter from the former line. page 5. line 9. for quarter, read half. p. 5. l. 13. *r.* of a quadrant. p. 11. l. 7. *r.* 63*d.* 26′. p. 19. l. 7. *r.* the same day to. p. 23. l. 17. *r.* and ends at 32′ past 9. p. 27. l. 7. *for* N R, *r.* N Z. p. 28. l. 4. *r.* in the parallel. p. 30. l. 9, & l. 10. *r.* 23*d.* 31′. p. 38. l. 4. *r.* Is to the sine. p. 50. l. 5. *r.* whereof the Diameter.